

The 35 USC 112 rejection set forth in Paragraph 8 of the Office Action is traversed on the grounds that the phrase "essentially free from" is not indefinite having regard to the context in which it is used and the explanation in the description as to the intended use of the claimed compounds. More specifically, it is submitted that the present situation is governed by *In re Marosi, Stabenow, and Schwarzmann*, 218 USPQ 289 (CAFC 1983) (hereinafter cited as "*Marosi*"), in which the Court of Appeals for the Federal Circuit specifically held the substantially synonymous phrase "essentially free of" not indefinite in a chemical claim on facts closely resembling the present situation.

In *Marosi*, the prior art processes for preparing zeolites required the presence of alkali metal in the reaction mixture, and the resulting alkali metal in the zeolite product had to be removed in a separate step before the zeolite was suitable for its intended use as a catalyst (see *Marosi* at 218 USPQ 290, right column). The applicants discovered that by using "a silicon dioxide source essentially free from alkali metal" in the process, it was possible to prepare an essentially alkali metal free product which did not require the alkali metal removal step. The problem applicants faced was that all commercial useful sources of silicon dioxide contained trace amounts of alkali metal, typically of the order of a few parts per million. Accordingly, the applicants defined the invention by the phrase "a silicon dioxide source essentially free from alkali metal". The evidence showed that the prior art reaction mixtures contained about 3,800 parts per million of sodium, whereas applicants' mixtures contained about 4 ppm.

The Court allowed the claim containing the phrase "essentially free of alkali metal" despite admitting that it was impossible to draw an exact numerical upper limit on the alkali metal content of the processes falling within the claim, stating:

[A]ppellants have provided a general guideline and examples sufficient to enable a person of ordinary skill in the art to determine whether a process uses a silicon dioxide source "essentially free of alkali metal" to make a reaction mixture "essentially free of alkali metal". We are persuaded that such a person would draw the line between unavoidable

impurities in starting materials and essential ingredients.
(*Marosi* at 218 USPQ 292, right column, paragraph
denoted "[2]")

In the present case, as discussed on pages 2-6 of this application, pentamethine squarate dyes are known to be useful as infra-red absorbers in various applications. In some of these applications, there are reasons to believe that asymmetric dyes (those which contain two different heterocyclic groups) would possess significant advantages. However, despite the potential advantages of asymmetric pentamethine squarate dyes, little research has been conducted on such dyes because of the difficulties involved in their synthesis. The main method described in the prior art for synthesis of such dyes is condensation of a heterocyclic compound with squaric acid. If one attempts to use this reaction to produce asymmetric pentamethine dyes, it is necessary to include two different heterocyclic compounds in the reaction mixture, and such a process inevitably produces three different products (two symmetrical dyes and the desired asymmetric dye), thus wasting at least half the starting materials (and possibly more if one heterocyclic compound is significantly more reactive than the other). Given that the costs of some symmetric pentamethine squarate dyes are high, such materials should be used judiciously and their loss minimized where possible.

Furthermore, separation of the tertiary product mixture produced is difficult, especially since, in many cases of practical importance, the two heterocyclic compounds used are chemically similar. For example, if one attempts to produce the dye of Formula A shown in Figure 1 of this application in which R^1 and R^2 are each a hydrogen atom (this dye contains one pyrylium nucleus and one selenopyrylium nucleus) simply by condensing a mixture of the two corresponding salts with squaric acid, it is extremely difficult to separate the desired asymmetric salt from the two, even on a laboratory scale, and conducting this separation on a commercial scale would be a practical impossibility. In some applications of infra red dyes, the presence of even minor amounts of symmetric by products in the desired asymmetric dye may cause significant problems. For example, as already noted, in the thermal imaging media

described in the aforementioned U.S. Patents Nos. 4,602,263 and 4,826,976, three separate imaging layers are present, having infra red absorbers with absorptions at 760, 820 and 880 nm. Conveniently, two of these three absorbers are Dye A shown in Figure 1, in which R^1 and R^2 are each a hydrogen atom, and the corresponding bis selenopyrylium dye. However, if Dye A is contaminated with even a small proportion of the corresponding bis selenopyrylium dye, serious problems may result in such a medium, in that the bis selenopyrylium impurity in the layer containing Dye A will absorb the "wrong" radiation, which may lead to unwanted exposure of parts of the layer containing Dye A and a reduction in sensitivity of the medium because the bis selenopyrylium impurity will absorb a large part of the radiation intended to cause color change in a different color forming layer.

The present inventors have devised a synthesis which enables asymmetric dyes to be produced essentially without contamination by the corresponding symmetric dyes, and hence should be able to claim the resultant, essentially pure dye which, to the best of their knowledge, has not been and cannot be prepared by the prior art synthesis, which inevitably produces a tertiary mixture. Although, given the ability of modern analytical techniques to detect impurities down to the parts per trillion level, the present inventors cannot guarantee that all dyes produced by their new process are absolutely free from the corresponding symmetric dyes (which could conceivably be produced by minor side reactions), they have found that the dyes they produce are essentially pure, and can be used in all applications of such dyes without interference from the symmetrical dyes. In these circumstances, although it may not be possible to specify an exact numerical limit for "essentially free from", the gap between the claimed dyes and the prior art mixtures, in which no more than about fifty percent is the desired asymmetric dye, is so great that *Marosi* applies, and the phrase "essentially free from" is not indefinite in the context in which it is used.

The 35 USC 103 rejections set out in Paragraphs 9-11 of the Office Action are traversed; more specifically, these rejections are traversed on the grounds that none of the references, alone or in combination would teach a person of ordinary

skill in the relevant art how to prepare the asymmetric dyes of the present invention essentially free from the corresponding symmetrical dyes, as required by the present claims. All of the references disclose preparation of the dyes by squaric acid condensation type procedures which, as discussed above with reference to the 35 USC 112 rejection, are inherently unsuitable for producing essentially pure asymmetric dyes.

Gravesteijn does indeed disclose alkyl(thio)pyrylium-squarylium compounds, in which the heteroatom may be oxygen or sulfur. Gravesteijn is, however, silent as to whether his variable X must be the same in both heterocyclic nuclei, and it is notable that his Examples 1 and 2 prepare the oxygen-oxygen and sulfur-sulfur compounds; there is no attempt to prepare an oxygen-sulfur compound. Furthermore, the only process disclosed for preparing the compounds is the condensation of squaric acid with two moles of the corresponding heterocyclic salt, a process which would inevitably produce a ternary mixture, and there is no guidance in Gravesteijn as to how to purify the ternary mixture to produce the asymmetric dye essentially free from the symmetric dyes. Accordingly, Gravesteijn does not reveal to the person of ordinary skill in the relevant art how to produce the essentially pure dye of the present invention, and the present claims are not obvious thereover.

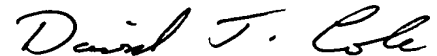
Katagiri is in essentially the same position as Gravesteijn. Although Formula (9) theoretically covers both symmetric and asymmetric dyes, every single one of the 22 specific compounds of Formula (9) set out in columns 75-82 of Katagiri is symmetric, and the only process for preparing these compounds described is the same as in Gravesteijn, namely the condensation of squaric (or croconic) acid with two moles of the corresponding heterocyclic salt (see Katagiri, column 81, line 44 to column 83, line 3, and Preparation Examples 4 and 5 in column 83). Accordingly, Katagiri does not reveal to the person of ordinary skill in the relevant art how to produce the essentially pure dye of the present invention, and the present claims are not obvious thereover.

Reconsideration and allowance of all claims remaining in this application is requested.

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Amendment of October 7, 1996
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A Petition for Extension of Time for the filing of this Amendment, and a check in payment of the Extension Fee prescribed by 37 CFR 1.17(a), are being filed herewith.

Respectfully submitted,



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CERTIFICATE OF MAILING

I hereby certify that this paper, dated October 7, 1996, is being deposited with the United States Postal Service as first class mail in an envelope addressed to Assistant Commissioner for Patents, Washington DC 20231, on *October 7, 1996*.



David J. Cole